# IMPERMEABLE METAL MICROCAPSULES FOR DIAGNOSTIC/THERAPEUTIC APPLICATIONS

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Until recently, small, volatile actives could not be efficiently encapsulated for timescales longer than a few days, due to the inherent porosity of the polymeric membranes used as the capsule shell material. Using electro-less deposition of metals, we have developed a method for preventing undesired loss of encapsulated actives using a simple 3 step process.1 The addition of a continuous metal shell prevents loss of the core into a solvent for the core over a period of 90 days, as opposed to polymeric capsules which lose their entire core in less than 30 minutes under the same conditions.

Polymer shell – oil core microcapsules are produced using oil-in-water emulsification followed by co-solvent extraction to precipitate a polymeric shell around the oil core, as first described in the work of Vincent et al.2, 3 Metallic catalytic nanoparticles are then physically adsorbed onto the microcapsule polymeric shells. Subsequently, this nanoparticle coating is used to catalyze the growth of a secondary metallic film.4
Here we investigate an exciting application of these metal microcapsules, as a vehicle for drug delivery, the rationale being that once a material is encapsulated in our capsules it cannot escape, until the capsules are broken by an external trigger. Thus, with a drug molecule that exhibits undesirable side effects trapped in the capsules, we can target the delivery site and fracture the capsules by application of an external force once they arrive at that location, removing the unwanted side effects which normally are associated with, for example, off-target effects of drug delivery in cancer treatment.

Previously poly(methyl methacrylate) (PMMA) has been utilized as the polymeric shell. However, in this work we demonstrate that PMMA can be substituted for poly(lactic-co-glycolic acid) (PLGA) a biocompatible and biodegradable polymer suitable for use as a drug carrier. We encapsulate perfluorooctyl bromide (PFOB), a tracer for ultrasound, as our model system, and then follow the steps described previously for growth of the metal shell.

We demonstrate that by using acoustic pulsed signals of varying intensity and time intervals, we can control the rupture of our metal capsules in an aqueous environment, to trigger release of PFOB into the external environment.

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